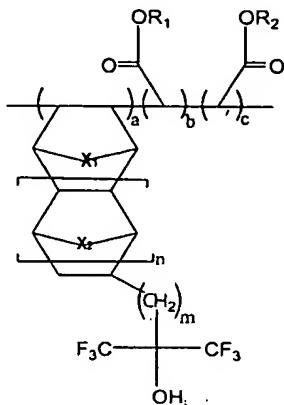


What is Claimed is:

1. A photoresist polymer comprising a repeating unit represented by

Formula 1:

Formula 1



wherein

X<sub>1</sub> and X<sub>2</sub> individually are selected from the group consisting of CH<sub>2</sub>, CH<sub>2</sub>CH<sub>2</sub>, O and S;

R<sub>1</sub> is selected from the group consisting of acid labile protecting group, C<sub>1</sub>-C<sub>20</sub> alkyl and C<sub>1</sub>-C<sub>20</sub> cycloalkyl;

R<sub>2</sub> is H, C<sub>1</sub>-C<sub>20</sub> alkyl, C<sub>5</sub>-C<sub>10</sub> cycloalkyl, or C<sub>5</sub>-C<sub>10</sub> cycloalkyl including an ether group, and C<sub>5</sub>-C<sub>10</sub> cycloalkyl including an ester group;

m is an integer ranging from 0 to 2,

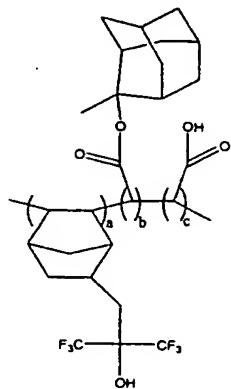
n is an integer of 0 or 1; and

the relative ratio of a : b : c is in the range of 50 mol% : 20~50 mol% : 0~30 mol%.

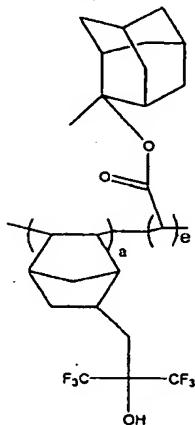
2. The photoresist polymer according to claim 1, wherein the acid labile protecting group is selected from the group consisting of t-butyl, tetrahydropyran-2-yl, 2-methyl tetrahydropyran-2-yl, tetrahydrofuran-2-yl, 2-methyl tetrahydrofuran-2-yl, 1-methoxypropyl, 1-methoxy-1-methyl ethyl, 1-ethoxypropyl, 1-ethoxy-1-methyl ethyl, 1-methoxyethyl, 1-ethoxyethyl, t-butoxyethyl, 1-isobutoxyethyl and 2-acetylment-1-yl.

3. The photoresist polymer according to claim 1, further comprising a repeating unit of Formula 2 or 3:

Formula 2



Formula 3



wherein

the relative ratio of a : b : c is in the range of 50 mol% : 20~50 mol% : 0~30 mol%; and

the relative ratio of a : e is 50 mol% : 50 mol%.

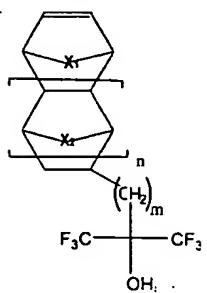
4. A method for forming a photoresist polymer, comprising the steps of:

(a) polymerizing a compound of Formula 7 and maleic-anhydride under the presence of polymer initiators to obtain a polymer of Formula 4;

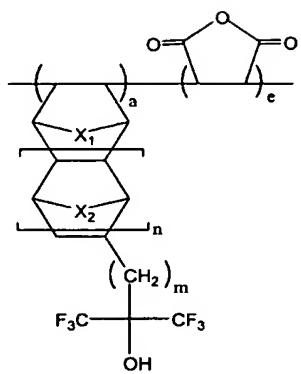
(b) reacting a polymer of Formula 4 with alcohol or an alkoixde compound and ring-opening maleic anhydride in the polymer to obtain a polymer of Formula 5; and

(c) esterifying or acetylating a partial or whole carboxyl group of a polymer of Formula 5 to obtain the repeating unit of following Formula 1:

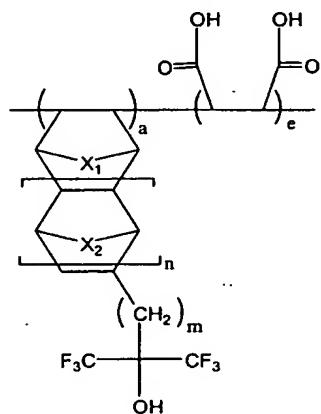
Formula 7



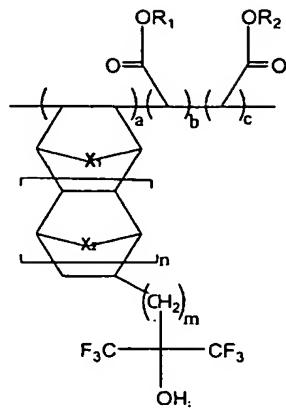
Formula 4



Formula 5



Formula 1



wherein

X<sub>1</sub> and X<sub>2</sub> individually are selected from the group consisting of CH<sub>2</sub>, CH<sub>2</sub>CH<sub>2</sub>, O and S;

R<sub>1</sub> is selected from the group consisting of acid labile protecting group, C<sub>1</sub>-C<sub>20</sub> alkyl and C<sub>1</sub>-C<sub>20</sub> cycloalkyl;

R<sub>2</sub> is selected from the group consisting of H, C<sub>1</sub>-C<sub>20</sub> alkyl, C<sub>5</sub>-C<sub>10</sub> cycloalkyl, C<sub>5</sub>-C<sub>10</sub> cycloalkyl including an ether group, and C<sub>5</sub>-C<sub>10</sub> cycloalkyl including an ester group;

m is an integer ranging from 0 to 2,

n is 0 or 1;

the relative ratio of a : b : c is in the range of 50 mol% : 20~50 mol% : 0~30 mol%; and

the relative ratio of a : e is 50 mol% : 50 mol%.

5. The method according to claim 4, wherein the polymerization of step (a) is performed using single or mixture solution selected from the group consisting of cyclohexanone, cyclopentanone, tetrahydrofuran, dimethyl-formamide, dimethylsulfoxide, dioxane, methylethylketone, benzene, toluene and xylene.

6. The method according to claim 4, wherein the polymer initiator of step (a) is selected from the group consisting of benzoyl peroxide, 2,2'-azobisisobutyronitrile (AIBN), acetylperoxide, laurylperoxide, t-butylperacetate, t-butylhydroperoxide and di-t-butylperoxide.

7. The method according to claim 4, wherein the polymer obtained from step (a) is crystallized and purified using single or mixture solution selected from the group consisting of dimethylether, petroleum ether, methanol, ethanol, lower alcohol including iso-propanol, and water.

8. A photoresist composition comprising a photoresist polymer of claim 1, a photoacid generator and an organic solvent.

9. The photoresist composition according to claim 8, wherein the photoacid generator is selected from the group consisting of phthalimidotrifluoromethane sulfonate, dinitrobenzyltosylate, n-decyl disulfone and naphthylimido trifluoromethane sulfonate.

10. The photoresist composition according to claim 9, wherein the photoacid generator comprises

(i) a first photoacid generator selected from the group consisting of phthalimidotrifluoromethane sulfonate, dinitrobenzyltosylate, n-decyl disulfone and naphthylimido trifluoromethane sulfonate ; and

(ii) a second photoacid generator selected from the group consisting of diphenyl iodide hexafluorophosphate, diphenyl iodide hexafluororoarsenate, diphenyl iodide hexafluoroantimonate, diphenyl p-methoxyphenylsulfonium triflate, diphenyl p-toluenylsulfonium triflate, diphenyl p-isobutylphenylsulfonium triflate, triphenylsulfonium hexafluororarsenate, triphenylsulfonium hexafluoro-antimonate, triphenylsulfonium triflate, and dibutyl-naphthylsulfonium triflate.

11. The photoresist composition according to claim 8, wherein the photoacid generator is present in an amount ranging from 0.05 to 10 wt% based on the amount of photoresist polymer.

12. The photoresist composition according to claim 8, wherein the organic solvent is selected from the group consisting of diethylene glycol diethyl ether, methyl 3-methoxypropionate, ethyl 3-ethoxypropionate, propylene glycol methyl ether acetate, cyclohexanone, 2-heptanone, and ethyl lactate.

13. The photoresist composition according to claim 8, wherein the organic solvent is present in an amount ranging from 500 to 2000 wt% based on the amount of photoresist polymer.

14. A method for forming a photoresist pattern, comprising the steps of:

- (a) coating the photoresist composition of claim 8 on a wafer to form a photoresist film;
- (b) exposing the photoresist film to light;
- (c) baking the exposed photoresist film; and
- (d) developing the resulting structure to obtain a photoresist pattern.

15. The method according to claim 14, further comprising performing a bake process before exposure of step (b).

16. The method according to claim 14, wherein the bake process is performed at a temperature ranging from 70 to 200°C.

17. The method according to claim 14, wherein the light is selected from the group consisting of ArF, KrF, EUV (Extreme Ultra Violet), VUV (Vacuum Ultra Violet), E-beam, X-ray and ion beam.

18. The method according to claim 14, wherein the exposure process is performed with exposure energy ranging from 0.1 to 100 mJ/cm<sup>2</sup>.

19. The method according to claim 14, wherein the development of step (d) is performed using an alkali developing solution.

20. The process of claim 14 for use in the manufacture of a semiconductor device.